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'CYANOTYPE AND ANTHOTYPE: ECO - PATTERNING WITH MINERAL AND NATURAL DYES.'

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Abstract:
The paper outlines collaborative research between two different disciplines: That of textile design and early colouration methods with historical photographic imaging techniques. The project considers the symbiotic relationship between natural plant extracts with 'Anthotypes' and raised colours specifically 'Prussian Blue' with 'Cyanotypes'. The aim of which, is to consider the question: Could this kind of photographic image making be applied as a future, sustainable method of design generation, colouration and patterning of fabric for fashion and interiors?

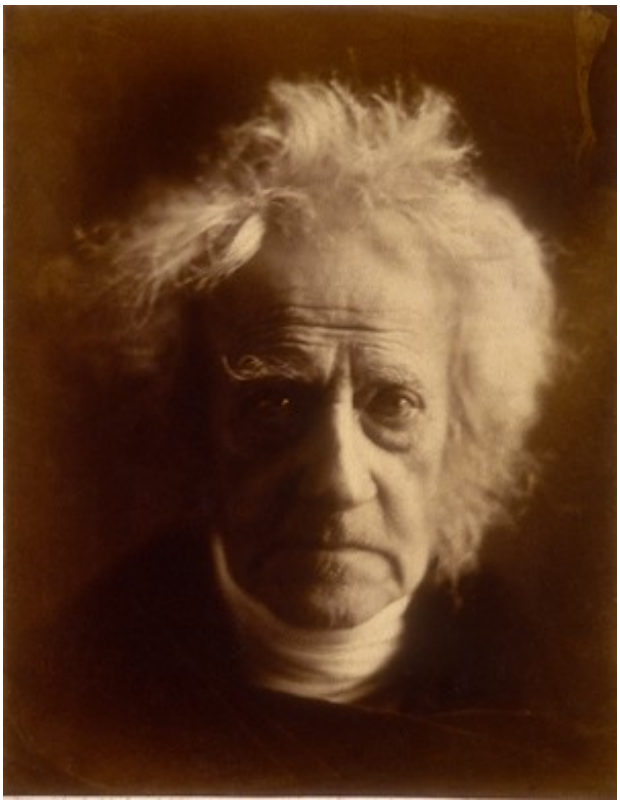
Looking at the substantive and the fugitive properties of the colouration materials along side different light wavelengths and analysing the success or failure of using Anthotypes and Cyanotype as an alternative sustainable surface design process can be attained: A form of Eco-patterning that relies upon light and natural substances/dyes not synthetic dyes as the colouring medium.

1. Introduction

This paper discusses a research project, which considered the correlation between Natural and Mineral dyes with early 19th Century photographic processes 'Cyanotypes' and 'Anthotypes' as a form of eco-patterning that relies upon light and natural subsantnces as the colouring medium. Initiated through an earlier research project titled the 'Emerging Evidence' which consisted of collaborative research between different disciplines: Fabric colouration (Dyeing) and alternative photography techniques investigated by two photographic students and the author in exploring the emergence of an image using early photograph techniques of cyanotypes and Anthotypes discovered by Hershel in the early part of the 19th Century.

The main objective of this research project was to look at the substantive and the fugitive properties of the colouration materials along side different light wavelengths as a way of analysing the success or failure of using Cyanotype and Anthotypes as an alternative sustainable surface design process. A more scientific/technical methodology was applied to a design process asking the questions: Why and How do Anthotypes work? What is the correlation of both colorant and positive have with sunlight? Do differing wave lengths, artificial daylight and ultra violet light effect the quality and colour of images achieved on exposure? What relationship does this have with the fastness properties of the natural dyes /plant extracts employed within the process?

The Cyanotype, often referred to as the Blue print process, which is the art of photographic printing in Prussian Blue, a mineral pigment and dye invented around 1700 and the Anthotype process, which employs flower and plant extracts to coat papers that when exposed for long periods of time in natural day light will produce photographic images, sometimes referred to as Herschel's Flower Essence Prints. [2] Both processes were said to have been invented and developed by Sir John Frederick William Herschel (1792-1871) in the early 1800s



(Figure 1).

Figure 2: Cyanotype of Periwinkle and Anthotype of Blackberry on Blackberry.

1.1 Cyanotypes on Paper & Fabric

Cyanotypes are based on the Mineral dye or Lake colour: Prussian blue. The process makes use of it sensitivity to light to be able to create photographic images or photograms on paper or fabric.

Prussian blue has never been found naturally and there is no knowledge of it existing before the 18th Century, but this substance still qualifies as one of the earliest synthetic pigments, dating from its first preparation probably in 1706, by Johann Jacob, an artists' colour-maker in Berlin. At this time Prussian blue was rapidly noticed by chemists of the time. Pierre-Joseph Macquer, author of the first chemical dictionary, was attracted to the substance and as government supervisor of the French dyeing industry, saw potential in the pigment in providing a fast dye for silk and wool. One of the earliest commercial uses found for Prussian blue was for dyeing all kinds of traditional fabrics - cotton, silk and woolen - in shades of blue, controlled by the details of the process. By the 19th Century, the industrial practice was to employ two baths: the first was a solution of a ferric salt, usually the nitrate or chloride, which mordanted strongly to the fibres of the fabric, then, after rinsing, it was followed by an acidic bath of potassium ferrocyanide, which formed the Prussian blue pigment in situ. [3]

It took around 100 years from the discovery of Prussian Blue to its use in creating photographic images. On 15th June 1842 Herschel's long awaited and important paper 'On the action of the rays of the Solar Spectrum on Vegetable Colours, and on new Photographic Processes was accepted for publication in 'The Philosophical Transactions of the Royal Society'. This described the Cyanotype process yet to be named as such until August that year. At first Herschel's invention was only taken up by a small élite of amateur botanists for the purpose

of plant illustration. The most notable achievement was that of Anna Atkins (1799-1871) who during two decades from 1843 produced beautiful cyanotype images of algae, ferns, feathers and waterweeds. [4]

The standard histories of photography do not record that any connection was made at this time between the light-sensitivity of ferric organic salts, and the known chemical properties of Prussian blue, which had been well-established as an artists' pigment and dye for over a century. But there was at least one such 'pre-photographic' observation in this respect. Made in 1828 by John Mercer (1791-1866), a Manchester colour chemist and calico-dyer, who noted the formation of Prussian blue on cotton by a light-induced reaction? Mercer's own description taken from his experimental notebooks quotes: [5]

> *'I spotted a piece of white cloth with a solution of pernitrate of iron, and exposed it to the sun. On testing it afterwards with a solution of red prussiate of potash it gave a blue - but no blue before exposure. This is worthy of note.*

I have not seen it noticed by any chemical writer.'

The pressure of maintaining his business evidently deprived Mercer of any opportunity to pursue this pioneering observation until 1847 when he did not follow up this discovery, and evolved the following method - by which time the 'invention of photography' had been carried out at the hands of others. for obtaining negative cyanotypes: [3]

> *"I found that if paper or cotton cloth is smeared with a solution of pernitrate or persulphate of iron with certain quantities of oxalic and tartaric acids, dried in the dark, then exposed to the light (solar), and immediately dipped in solution of red Prussiate containing a little free sulphuric acid (preferably free from yellow prussiate), where the light has caused deoxidation, the blue is fixed, and where the peroxide remains unchanged there is no colour. The cloth or paper must be washed immediately in water containing a little sulphuric acid, and afterwards in pure water. The picture is a reverse blue print."*

1.2 Anthotypes

The word Anthotype is derived from the Greek word *anthos* for flower. Herschel in his quest to explore the new science of photography applied his current knowledge of light, colour and botany and started to experiment with making images through light using extracted flower pigmentation. [6]

Herschel mentioned anthoypes in 1840 in a paper to the Philisophical Transactionsn of the Royal Society called *On the Chemical Action of Rays of the Solar Spectrum on Preparations of Silver and other substances, both metallic and non-metallic, and on some photographic Processes*. [2]

In it he described trying to speed up the bleaching action of vegetable juices by isolating specific rays of the spectrum with a prim and noted the reaction, effect.

> *"We all know that colours of vegetable origin are usually considered to be destroyed and whitened by the continued action of light. The process, however, is too slow to be made the subject of any satisfactory series of experiments; and as a consequence, this subject, so interesting to the painter, the dyer, and general artist , has been allowed to remain uninvestigated.* [2]

By 1842 in a paper to the Royal Society he thus describes the experimentation. [6]

> *On the action of rays ….. In operating on the colours of flowers I have usually proceeded as follows: The petals of the fresh flowers, or rather such parts of them as possessed a uniform tint, were crushed to a pulp in a marble mortar, either alone, or with the addition of alcohol, and the juice expressed by squeezing the pulp in a clean linen or cotton cloth. It was spread on paper with a flat brush, and dried in the air without artificial heat, or at the most with a gentle heat that rises in the ascending current of air from an Arnott stove.*

but Herschel's experimentation with Anthotypes was very short lived by early spring 1842 Herschel had suspended his tests on plant colours in favour of further broadening his search for new photosensitive substances.
The technique today remains unchanged for application to paper. Where plant extracts are applied to the surface of 100% rag papers and exposed with a 'Positive' in contact with the coating and left for hours/days/weeks or months to expose in natural day light. Eventually creating a photographic image.

2. Materials and Methods

The key text on Anthotypes written by Marlin Fabbri [2] and other research and design interests into fugitive nature of Natural Dyes made the obvious connection linking light fastness combined with wavelength to the success or failure of the Anthotype process for fabric as an sustainable eco form of decoration although inital research had highlighted connections with different light wavelengths even in the original writtings of Herschel via Hunt in 1844 which contained very early light research contained in a chart/graph that plots different substances and chemicals including Ferrocyanate of Potash (Cyanotype) and the plants that Herschel experimented with in early Anthotypes (Ten Week Stocks, Wallflowers, Corchorus Japonica and Green Leaves) against the Solar Spectra of Light, Heat and Energia [1]

Experimentation started by employing the natural plants and juice extractions of flowers and leaves obtained from the Cotesbach Hall Gardens alongside investigations and experimentation into 'Cyanotypes' and 'Anthotypes' Concentating on Anthotypes as a eco form of patterning with the aim to understand the relationship that the natural colorant (Dye) has with types of light and its relationship as to the success or failure of this type of photographic process for fabrics.
As the research progressed the following questions of enquiry were posed:
Why and How do Anthotypes work?
What is the correlation of both colorant and positive have with sunlight?
Do differing wave lengths, artificial daylight and ultra violet light effect the quality and colour of images achieved on exposure?
What relationship does this have with the fastness properties of the natural dyes /plant extracts employed within the process?

Plant and flower juices were extracted in the same manner as Herschels inital experimentations in 1842 using Vodka and Surgical spirit for alcohol extraction with a Marble Mortar and painting the plant extracts onto the surface of the material although further work has been carried out by Ness Greger by employing fast and fugitive natural dyes aplied via the normal aqueous system along side an Alum mordant to form a base for experimentation. Which resulted in very sucessful patterning although colour control is restricted due to natural dye selection (Figure 3).

Figure 3. Anthotype: Woad dyed base colour over dyed with Turmeric.

3. Conclusion

"The Artists go on boldly, and are not afraid to be Chemists,
the Chemists gain courage and long to be Artists."
The Athenæum 1858 [7]

As an eco form of patterning that uses light as the main catylyst for cloth decoration the use of cyanotyes is well known and the revival of light sensitive vat dyestuffs is well documented and commercially sucessful but the application of Natural dyes as Anthotypes is still at investgatory stages and will rely on changes in attitude to the permanence of a pattern or colour but provides an interesting challenge in eco patterning to take into further research.

This research project will be extended into the science of plant colour and the absorption of different colouring chemicals such as Flavonoids and Anthocyanin's have in relation to the different light wavelengths and the fading of plant extractions and traditional Natural dyes.

By looking at different solubility of colouring materials touched upon by Hubble in 1885 [8] and expanded upon by Lee "Natures Palette: The Science of Plant Colour. [9] Improvements in increasing the light fastness by applying after mordant such as Iron or Copper acetates to the Anthotypes after exposure or as resent research has revealed the use of UV blockers such as Vitamin C that does not normally affect the colour of the prints.

Keywords: Anthotypes, Cyanotypes, Fastness, Fugitive, Natural Dyes,

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